Linear Programming

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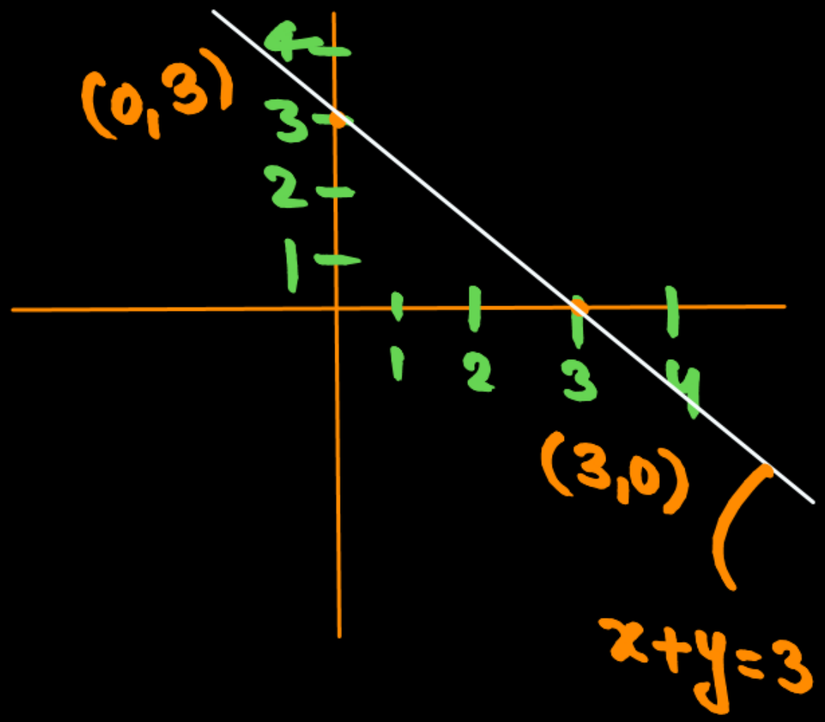
Introduction

$x+y=3$ – linear Equation in two Variable

x	0	3
y	3	0



Linear ineq. ($>, <, \leq, \geq$)

$x+y \leq 3$

$x=0, y=0$

$0+0 \leq 3$

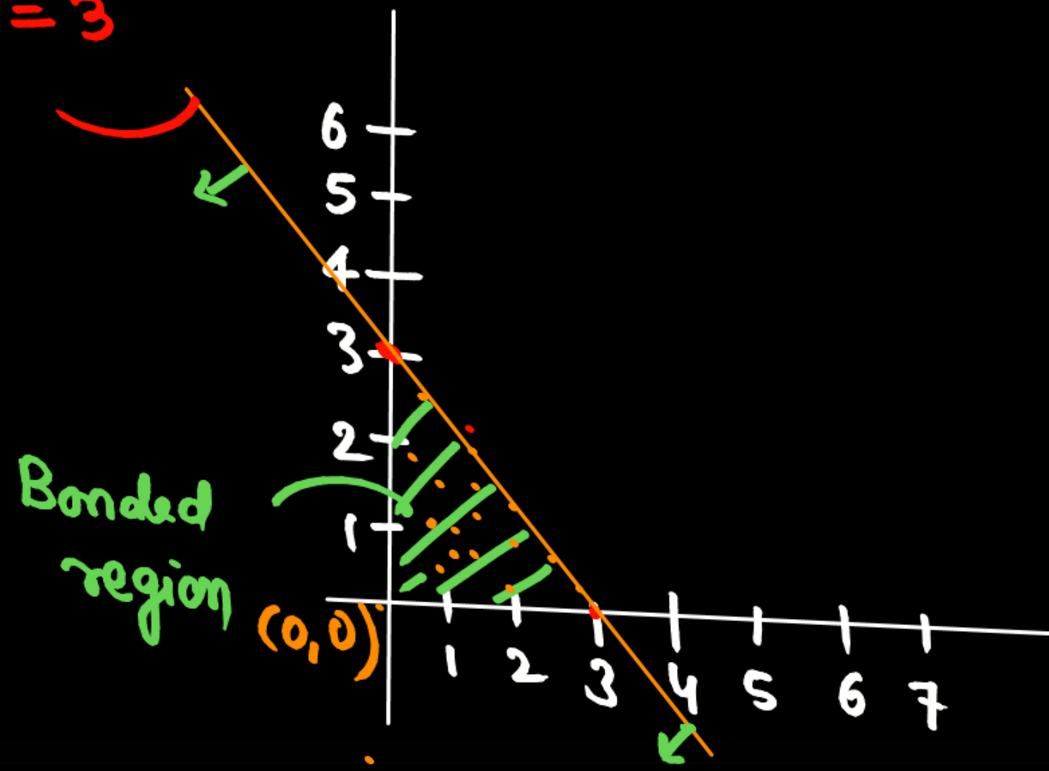
$0 \leq 3$

True

$x+y=3$

$x+y=3$

x	0	3
y	3	0



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$x+y \geq 3$

$x+y=3$

x	0	3
y	3	0

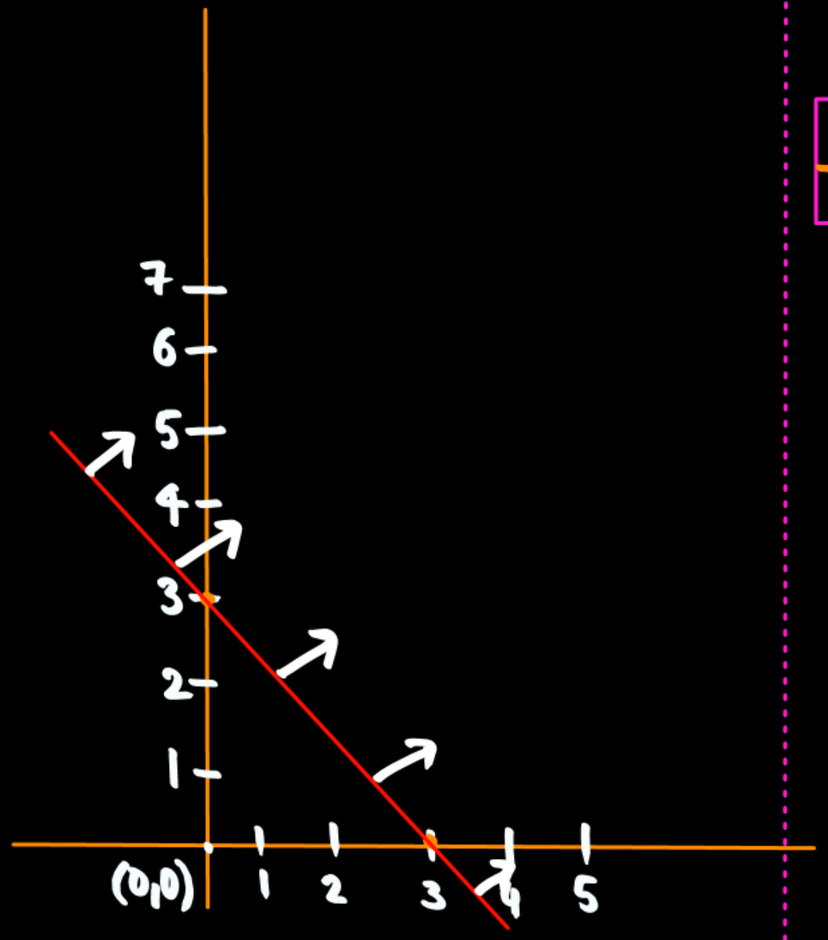
$x=0, y=0$

$x+y \geq 3$

$0+0 \geq 3$

$0 \geq 3$

False



$x+y > 3$

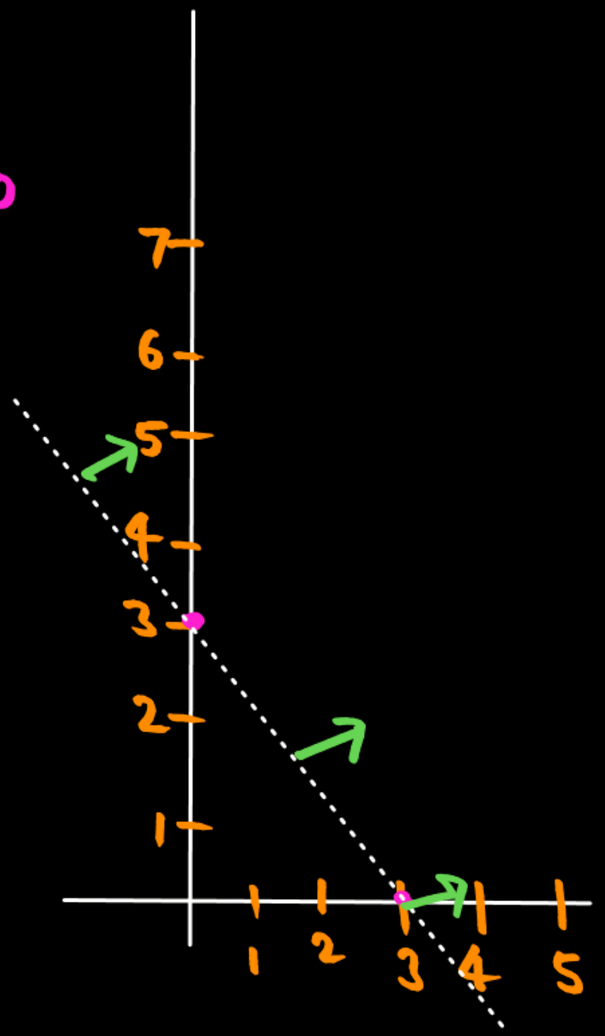
x	0	3
y	3	0

$x=0, y=0$

$0+0 > 3$

$0 > 3$

False



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Q-1 Solve the following linear programming problem graphically maximize and minimize $Z = 60x + 15y$ subject to the constraints $x + y \leq 50, 3x + y \leq 90, x, y \geq 0$

$0+0 \leq 50$ (True) $x+y \leq 50$

$0+0 \leq 90$ $3x+y \leq 90$

} Condition.

↑

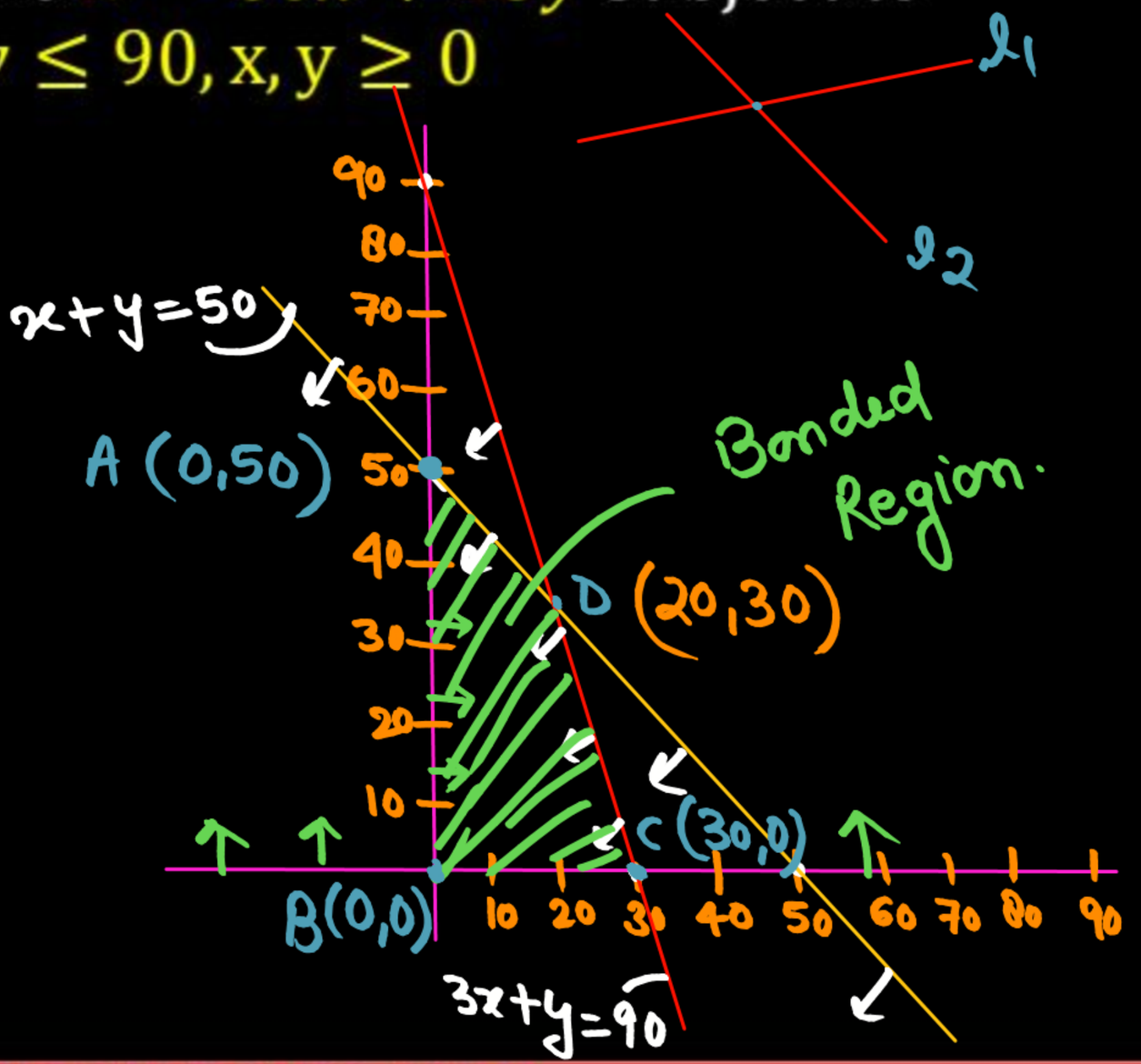
First q. $\begin{cases} x \geq 0 \\ y \geq 0 \end{cases}$ Non-negative Constraints

$x+y=50$

x	0	50
y	50	0

$3x+y=90$

x	0	30
y	90	0



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$$x + y = 50$$
$$3x + y = 90$$
$$-2x = -40$$

$$x = 20$$

$$y = 30$$

Points	$Z = 60x + 15y$
A(0,50)	750
B(0,0)	0
C(30,0)	1800
D(20,30)	$= 1200 + 450$ $= 1650$

Smallest

greatest

Max → C(30,0), Z = 1800

Min B(0,0), Z = 0

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Q-2 Solve the following problem graphically:

Maximize $Z = 5x + 2y$ Subject to the constraints $3x + 5y \leq 15$,

$5x + 2y \leq 10, x, y \geq 0$

$x = 0, y = 0$

$3x + 5y \leq 15 \quad 0 \leq 15$ True

$5x + 2y \leq 10 \quad 0 \leq 10$ True

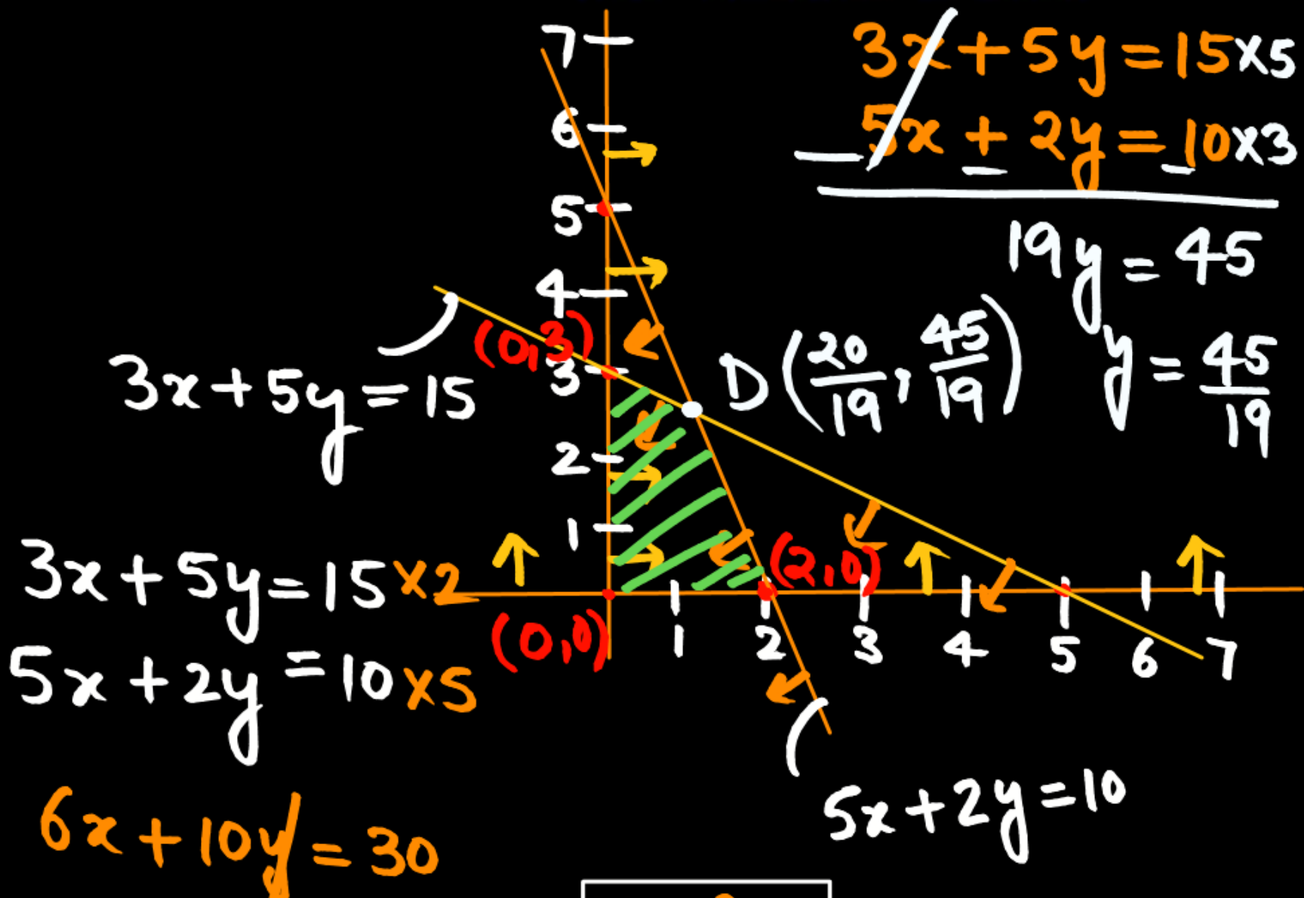
$x \geq 0$, $y \geq 0$ } First q.

$3x + 5y = 15$

x	0	5
y	3	0

$5x + 2y = 10$

x	0	2
y	5	0



$3x + 5y = 15 \times 5$

$5x + 2y = 10 \times 3$

$19y = 45$

$y = \frac{45}{19}$

$3x + 5y = 15 \times 2$

$5x + 2y = 10 \times 5$

$6x + 10y = 30$

$25x + 10y = 50$

$-19x = -20$

$x = \frac{20}{19}$

$y = \frac{45}{19}$

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Points	$Z = 5x + 2y$
$A(0,3)$	$Z = 6$
$B(0,0)$	$Z = 0$
$C(2,0)$	$Z = 10$
$D\left(\frac{20}{19}, \frac{45}{19}\right)$	$Z = \frac{100}{19} + \frac{90}{19} = \frac{190}{19}$ (10)

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Q-3 Find graphically the maximum value of $Z = 2x + 5y$,Subject to constraints given below $2x + 4y \leq 8, 3x + y \leq 6, x + y \leq 4$,$x \geq 0, y \geq 0$

$2x+4y \leq 8$, $3x+y \leq 6$, $x+y \leq 4$ $x \geq 0$, $y \geq 0$

$2x+4y=8$

x	0	4
y	2	0

$0 \leq 8$ True

$3x+y=6$

x	0	2
y	6	0

$0 \leq 6$ True

$x+y=4$

x	0	4
y	4	0

$0 \leq 4$ True

$x=0$, $y=0$

$3x+y=6$

$x+y=4$

$2x+4y=8$

$A\left(\frac{8}{5}, \frac{6}{5}\right)$

(0,2)

(0,0) (2,0)

$3x\frac{8}{5}+y=6$

$y=6-\frac{24}{5}$

$y=\frac{6}{5}$

$3x+y=6 \times 4$

$2x+4y=8$

$12x+4y=24$

$-\ 2x+y=8$

$10x=16$

$x=\frac{16}{10}=\frac{8}{5}$

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Point	$Z = 2x + 5y$
$A\left(\frac{8}{5}, \frac{6}{5}\right)$	$\frac{16}{5} + \frac{30}{5} = \frac{46}{5} = 8.$
$B(2,0)$	$Z = 4$
$C(0,0)$	$Z = 0$
$D(0,2)$	$Z = 10$

Max $D(0,2)$ $Z = 10$ Ans

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Q-4 Maximize and minimize $Z = 5x + 10y$ subject to the constraints

$x + 2y \leq 120, x + y \geq 60, x - 2y \geq 0, x \geq 0, y \geq 0$

$x+2y \leq 120$

$x+2y = 120$

x	0	120
y	60	0

$0 \leq 120$

True

$x+y \geq 60$

$x+y = 60$

x	0	60
y	60	0

$0 \geq 60$

False

$x-2y \geq 0$

$x-2y = 0$

x	0	0
y	0	0

$0 \geq 0$

$x+y = 60 \times 2$

$x-2y = 0$

$3x = 120$

$x = 40$

$40 - 2y = 0$

$2y = 40$

$y = 20$

$x-2y = 0$

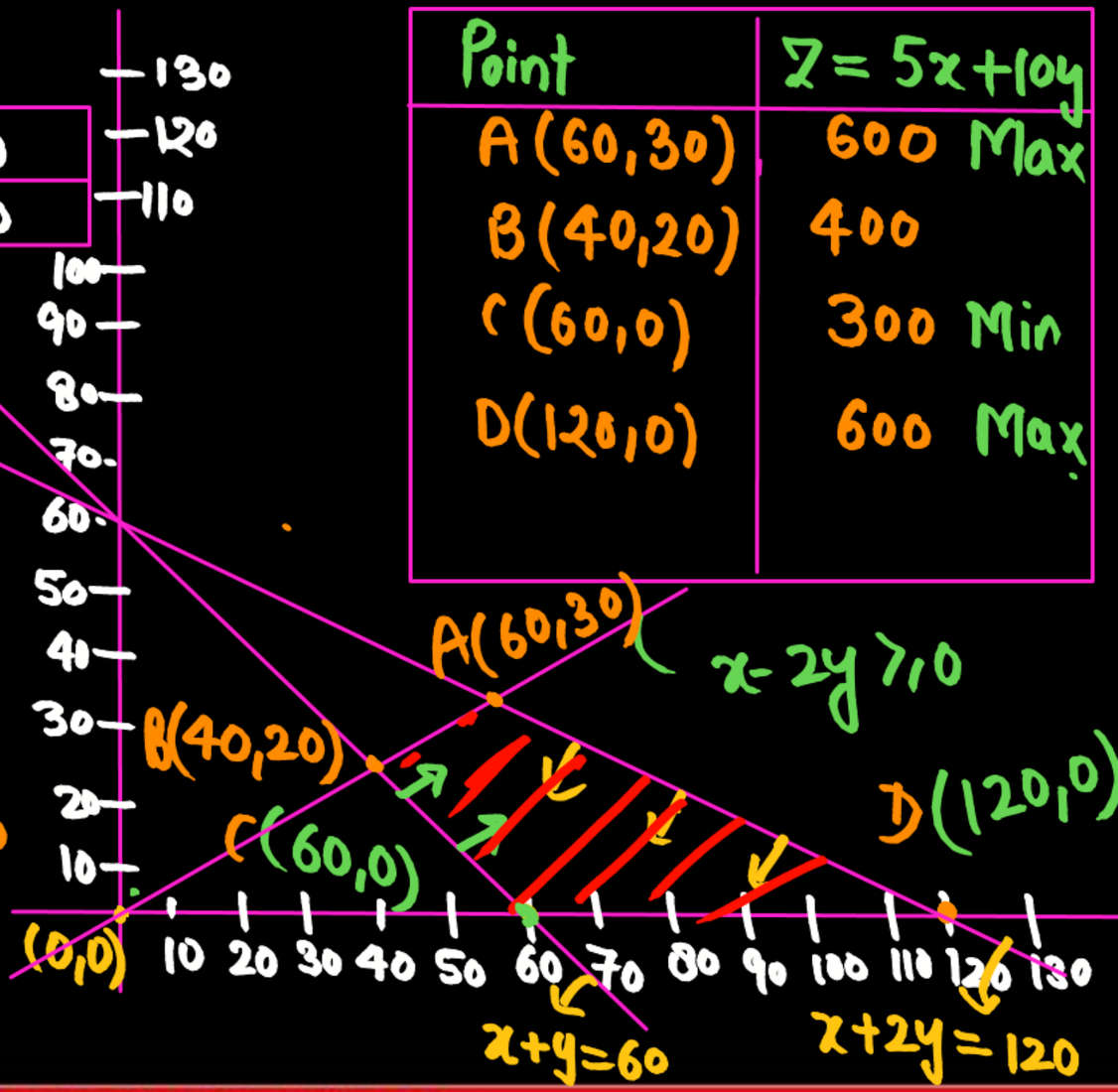
$x+2y = 120$

$2x = 120$

$x = 60$

$-2y = -60$

$y = 30$



Point	Z = 5x+10y
A(60,30)	600 Max
B(40,20)	400
C(60,0)	300 Min
D(120,0)	600 Max

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Q-5 Solve the following linear programming problem graphically: minimize Z=3x+5y subject to the constraints:
$x + 2y \geq 10, x + y \geq 6, 3x + y \geq 8, x \geq 0, y \geq 0$

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Thank You!

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